AMENDMENTS TO THE SPECIFICATION

Please amend Paragraph [0007] as follows:

[0007] Although a helical scan CT can cover the required scanning distance (20–30 cm) during a normal ~~breathe~~ breath hold, and thus completely scan the tumor during this ~~breathe~~ breath hold, the radiation therapy is a relatively long process and takes around 15 minutes. Therefore, it is not possible for a patient to hold his ~~breathe~~ breath during the therapy procedure. When a person breathes, the internal organs move by as much as several centimeters, causing the tumors to move in and out of the radiation treatment field. As a result, the respiratory motion of the patient causes the tumor to be blurred, lack clarity, distorted, and to appear larger or smaller than its actual size. Moreover, the radiation dose to the patient from the radiation therapy tends to irradiate, and thus damage, the normal tissue surrounding the tumor.

Please amend Paragraph [0028] as follows:

[0028] Referring to Figure 1 and Figure 2 a representative CT imaging system 1 is shown and includes, but is not limited to, a gantry 2 having an x-ray source 4, a radiation detector array 6, a patient support structure 8 and a patient cavity 10, wherein x-ray source 4 and radiation detector array 6 are opposingly disposed so as to be separated by patient cavity 10. A patient 12 may be disposed upon patient support structure 8, which is then disposed within patient cavity 10. X-ray source 4 projects a ~~x-ray beam 14~~ radiation beam 14 toward radiation detector array 6 so as to pass through patient 12. Radiation beam 14 may be collimated by a collimate (not shown) so as to lie within an X-Y-Z volume of a Cartesian coordinate system referred to as an "imaging volume". After passing through and becoming attenuated by patient 12, attenuated x-ray beam 16 is received by radiation detector array 6. Radiation detector array 6 includes, but is not limited to a plurality of detector elements 18 wherein each of the detector elements 18 receives attenuated x-ray beam 16 and produces an electrical signal responsive to the intensity of attenuated x-ray beam 16.

Please amend Paragraph [0030] as follows:

[0030] Control mechanism 20 controls the rotation and operation of x-ray source 4 and/or radiation detector array 6. Control mechanism 20 includes, but is not limited to, an x-ray controller 22 communicated with x-ray source 4, a gantry motor controller 24, and a data acquisition system (DAS) 26 communicated with radiation detector array 6, wherein x-ray controller 22 provides power and timing signals to x-ray source 4, gantry motor controller 24 controls the rotational speed and angular position of x-ray source 4 and radiation detector

array 6 and DAS 26 receives the electrical signal data produced by detector elements 18 and converts this data into digital signals for subsequent processing. CT imaging system 1 may also include an image reconstruction device 28, a data storage device 30 and a processing device 32, wherein processing device 32 is communicated with image reconstruction device 28, gantry motor controller 24, x-ray controller 22, data storage device 30, an input device 34 and an output device 36. Moreover, CT imaging system 1 may also ~~includes~~ include a table controller 38 communicated with processing device 32 and patient support structure 8, so as to control the position of patient support structure 8 relative to patient cavity 10.

Please amend Paragraph [0034] as follows:

[0034] To obtain images/apply radiation therapy (e.g., images of tumors), patients are asked to breath normally or ~~couched~~ coached to breath in a regular pattern. Patients are scanned employing standard axial scanning protocol. Other scanning protocols are possible, an axial scan is discussed here for illustrative purposes. Scan duration is selected as the period of maximum respiratory cycle of the patient 40 plus rotation time of the scanner gantry 2. Once the scanning is complete, the table 8 and thereby the patient 12 is translated by a distance equal to the number of detectors 18 times the width of each detector 18. For example, for a scanner with 8 detectors and of width 2.5mm, the table 8 is translated by 20 mm. The axial scan is resumed in the new position and the imaging/translation process is repeated until the entire region of interest e.g., organ is covered. Separate equipment may be employed to monitor and record patient breathing/respiratory cycle 40 and state of the X-ray signal i.e. the on and off states.

Please amend Paragraph [0035] as follows:

[0035] Referring to Figure 3, a flow chart depicting an exemplary method 100 is provided for synchronizing images of a patient 12, obtained via an imaging system 1, using respiratory gating in accordance with a first embodiment is shown and discussed. As stated earlier, for retrospective respiratory gating, the scanned images are synchronized with selected phases of a particular physiological characteristic, namely, in this embodiment, a respiratory cycle 40 to compensate for respiratory motion. It will be appreciated that while the physiological characteristic disclosed herein is a respiratory cycle, without a loss of generality, numerous variations are possible. Respiratory cycle as used herein is for illustrative purposes. For effective synchronization, it is necessary to define a reference point 50 in every respiratory cycle 40 and quantify each phase with respect to the reference point 50. While current methodologies include some breathing phase estimation and synchronization, these methodologies are inaccurate for the first few seconds of data

acquisition. ~~Discloses~~ Disclosed herein is a methodology for assigning phases in the respiratory cycle 40 for retrospective respiratory gating that overcomes this limitation and addresses some of the issues presented by internal organ movement as it relates to a patient's respiration for imaging and treatment.

Please amend Paragraph [0038] as follows:

[0038] In an alternative embodiment, another methodology for retrospective respiratory gating is disclosed. Referring to Figures 1 and 6, a generalized block diagram depicting a simplified portion an imaging system such as imaging system 1 for respiratory gating. In this embodiment, the CT imaging system 1 may be supplemented with a system. Referring now to Figure 7 in addition to Figures 1 and 6 to facilitate execution of the respiratory gating, a respiratory cycle 40 is divided into N substantially equal parts. Each part corresponds to a specific respiratory phase of the respiratory cycle 40. Images are generated/acquired at time interval t = T/N (where T is the period (time duration) of the respiratory cycle 40). This process is substantially similar to that described in the abovementioned embodiment and therefore only distinctions are addressed here for clarity. The patient's respiratory waveform 60, e.g., a signal indicative of the patient's respiratory cycles, the state of the X-ray signal 62 and images are post processed utilizing an image post processing work station 29, or the like, and sorted based upon a selected/assigned phase and spatial position. More specifically, for each detector 18 position, a temporal bin (e.g., storage location(s)) comprising N slots is generated and every image is assigned a slot based upon its phase and spatial position for that detector position. The phase of each image is determined with respect to the respiratory waveform 60. Zero phase may be defined either as the maximum point or the minimum point of the respiratory waveform 60. It will be appreciated that while a maximum or minimum is selected for ease of illustration, a zero phase point may be defined for any point along the respiratory waveform 60. Similar to the above embodiment, a minimum is selected for illustration purposes. The state of the X-ray signal is used to synchronize the respiratory waveform 60 with captured images. Respiratory waveforms 60 or portions thereof recorded during X-ray off states (non-radiating) are not used for determining the phase of images. The phases of respiratory waveform need to be determined (zero phase, etc). However, only the phases corresponding to the images will be used. In this manner, ~~phase~~ phases associated with non-imaged data are avoided.

Please amend Paragraph [0042] as follows:

[0042] In yet another exemplary embodiment, an enhancement to the imaging of a patient may be achieved with a cine acquisition mode (detector parked at the same location

for data acquisition) with or without gating of the respiratory information. In this embodiment, each acquisition covers a complete respiratory cycle 40 plus a reconstruction window. The reconstruction window is equivalent to the time duration for 2/3 of a complete gantry 2 rotation time or one complete gantry 2 rotation time, depending on the reconstruction of either half or full scan reconstructions respectively. It will be appreciated that existing CT imaging is often performed utilizing either a 180 degree plus fan angle of detector or 360 degree scan corresponding to half plus fan and full gantry rotations. A series of acquisitions is made to cover the area of interest. The additional reconstruction window ensures that all the phases of a complete breathing/respiratory cycle 40 will be represented in the series of images reconstructed with spacing of $\Delta t \ll 2/3$ (or 1) complete gantry rotation cycle. For example, without loss of generality, it will be appreciated that existing CT systems exhibit a gantry rotation time of about 0.5 sec. In this instance, for example, the required acquisition time will therefore be the duration of one respiratory cycle 40 plus 0.33 or 0.5 sec. for half or full scan reconstructions, respectively. If respiratory information e.g., a respiratory waveform 60 (FIG. 7) was collected and synchronized with the reconstructed images, it will be appreciated that it is now conceivable to register the images of the same phase across multiple cine acquisition locations to generate all phases of two-dimensional (2D) images across multiple locations. Moreover, and significantly, it will be appreciated that four-dimensional (4D) images (i.e., three-dimensional (3D) data plus time) may be generated. Uniquely, if no respiratory information is collected to supplement the image reconstruction, post-processing may be employed to register the images of the same phases across the images taken at different respiratory cycles 40. The post processing would involve measurements in an ROI (region of interest) at locations sensitive to the breathing motion, such as, for example, the liver and lung interface or the outer surface of the abdomen, to estimate the phases of the respiratory motion cycle. and utilizing the measurement information to register the images of the same phases across the images taken at different respiratory cycles 40. For example, The phase information my <u>may</u> be derived by placing a region of interest on an organ related to respiratory motion, e.g., rib cage, or liver, to obtain the images. The sum of the images in the region of interest would indicate the phases of breathing.